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STATUS OF A COMPUTER MODEL FOR MANAGEMENT OF MOOSE POPULATIONS

By

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INTRODUCTION

The moose is economicaly the most important of the game species in Norway. In 1975 the kill was 10 000 moose. This represents a meat value of about 30 million N.Kr.

The moose is a robust animal. It appears quite able to adapt to modern forestry practices. To some extant it has also proven possible to manipulate the populations to obtain the desired yield. However, the moose ecology is complicated. It is difficult to overview and understand all the relationships and to plan and manage the entire moose-forest ecosystem.

Therefore, Norwegian big game biologists have turned their attention to mathematical modelling and simulation of cervide populations. We feel that this way of analysing may contribute to a better understanding and management of cervide populations. This paper deals with some results of this work and also discusses our plans for the future.

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RESULTS

Fig. 1 roughly illustrates the "moose-forest" system. Arrows indicate the relations and interactions between the sub-models. Of these sub-models, we have finished the populations model. We also have a forest succession model and an energy model. Although these are not yet finished, it is possible to run them.

The population model

In Norway hunters are responible for 85-90% of the total mortality in a moose population. (Haagenrud and Lørdahl, in prep) The populations are therefore controlled and regulated by hunting, and it is possible to manipulate the population by selective hunting in order to give the desired future harvests. This is one of the basic facts the model is built on. Every calculations in the model in principle change the number of animals and the sex and age structure in the population. The model contains our knowledge of moose populations regarding reproduction, natural mortality, sex rates etc.

In the model reproduction is dependent on age of the females and can be changed from year to year based on observations, or can be made dependent on condition of the animals or on random changes. Natural mortality can be made dependent on age. Calf mortality can depend on the age of the mother, motherless calves can have higher mortality than calves which stay with their mother, throughout winter. We can also include weight of the animals in the different age and sex groups. The model gives printouts four times a year. The most important are after calving and hunting.

As hunting is the most important mortality factor, we have formulated different hunting strategies which make it possible to "play" with the model. We can also use historical data

and make test simulations of a known population, or we can use the model to predict the development of a population.

Fig. 3 shows an example of one of the outsprint from the model. This gives information on sex and age structure, number of animals in population and in harvest, etc. Further details are given by Digernes and Rusten (In press).

The energy model

The energy model was originally constructed for reindeer (Rusten 1975). It calculates the total food requirement of a population according to population density, activity, weights of the animals etc. The model calculates changes in body weight, reproduction and mortality. This connects the energy model to the population model. Lack of information on activity, metabolism and energy costs of the different activities and processes litims the informative value of the energy model.

The forest-succession model

This model has been programmed and developed by Lie (1976). At this stage the model calculates forest succession and gives information on quantity of food produced/available. The model should be regarded as showing principles of simulation, rather than exact values.

The other sub-models needed are still under discussion. First of all these models will include a behaviour/activity model and a grazing/browsing model. The behaviour model should describe the activity, habitat preferance and grazing habits in different seasons. The grazing model will determine the grazing pressure on different species and sites according to the grazing habits and food requirment of the moose. It will also report to what extent the food requirement is satisfied.

DISCUSSION

By this project we intend to develop a model for management of the moose-forest.system. This will certainly be a langthy undertaking. However, we will discuss here some "pros and cons" of this method of studying ecological systems.

The population model has given us usefull information on the dynamic of moose and other cervide populations and can certainly be used in management. For this use we need data on initial size and structure, of the population and data on reproduction and mortality. We also need some "check points" for the population curve, i.e.the structure and number of animals in the population. Dependent on the production of the population, these "check points" will be needed every 3rd or 4th year. Every year we will also need information on calf production, and on the number of animals harvested in the different sex and age classes (i.e. calves, yearlings and adults).

Preliminary results of studies of moose populations in Norway seem to indicate that some of this information can be collected from hunters (Haagenrud et. al. 1975).

The energy budget of moose is totally unknown and data do not even exist concerning their most elementary physiological processes. By working with tame moose and using the research methods of animal husbandry, these data would be obtainable. A problem is the size of the moose and the difficulties involved in handling such a big animal. However, our experience with one yearling currently in captivity at the College of Agriculture has given some reason for optimism.

There is much knowledge concerning plant succession and production in the boreal conifer forest. However, interest has been concentrated on fiber production. Therefore only

limited information and data usable in the moose - forest model are available.

Conclusion: The purpose of this project is to make a mathematical model for the management of moose populations. However, data are scanty and the value of the modelling work is of course dependent on these.

An important question in this connection is the strategy of the modelling work. This we can present in two ways:

1) Postpone model work until sufficient data have been collected.

2) Build the model on general information, available data and guessing. The model may then be used to determine which data are most urgent and which are of lesser importance, as well as the accurancy needed for a particular set of data, in other words the priorities of research.

Our question is whether we today have enough "hard data" on moose behaviour, food requirements, energy expenditure and habitat food production to defend this type of total model approach at all? Maybe we do not need a complicated and expensive model to guide our data collecting work these first years?

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RT FROM YEAR 1975 BEFORE HUNT

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F TOTAL HERD                                          % OF TOTAL HERD

TEREPORT

E OF HERD                  15077
E ADULTS                   11.93 % (    1799 ANIMALS)
ALE ADULTS                 37.28 % (    5620 ANIMALS)
RLINGS                     24.20 % (    3648 ANIMALS)
LE YEARLINGS               58.77 % (    2144 ANIMALS)
VES                        26.60 % (    4010 ANIMALS)
LE CALVES                  58.75 % (    2356 CALVES)
IN SHARE OF CALVES         34.66 % (    1390 CALVES)
MALS DEAD IN VINTER          .00 % (     100 ANIMALS)
VES BORN                   36.23 % (    4010 CALVES)
VES DEAD IN SUMMER           .00 % (       0 CALVES)
DUCTIVE SEX RATIO            .31
 INCREASE LAST YEAR        35.01 % (    3910 ANIMALS)
E RATIO                     1.08

NTREPORT

TAL HUNT QUANTITY (%)      22.68 % (    3276 ANIMALS)
NTQUANTITY IN KILO     623389.00
LVES                         .00 % (       0 ANIMALS)
ALE CALVES                   .00 % (       0 CALVES)
ARLINGS                    36.63 % (    1200 ANIMALS)
ALE YEARLINGS              75.00 % (     900 ANIMALS)
MALE ADULTS                15.26 % (     500 ANIMALS)
LE ADULTS                  48.11 % (    1576 ANIMALS)
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g 2. Example of outprint from the population model.

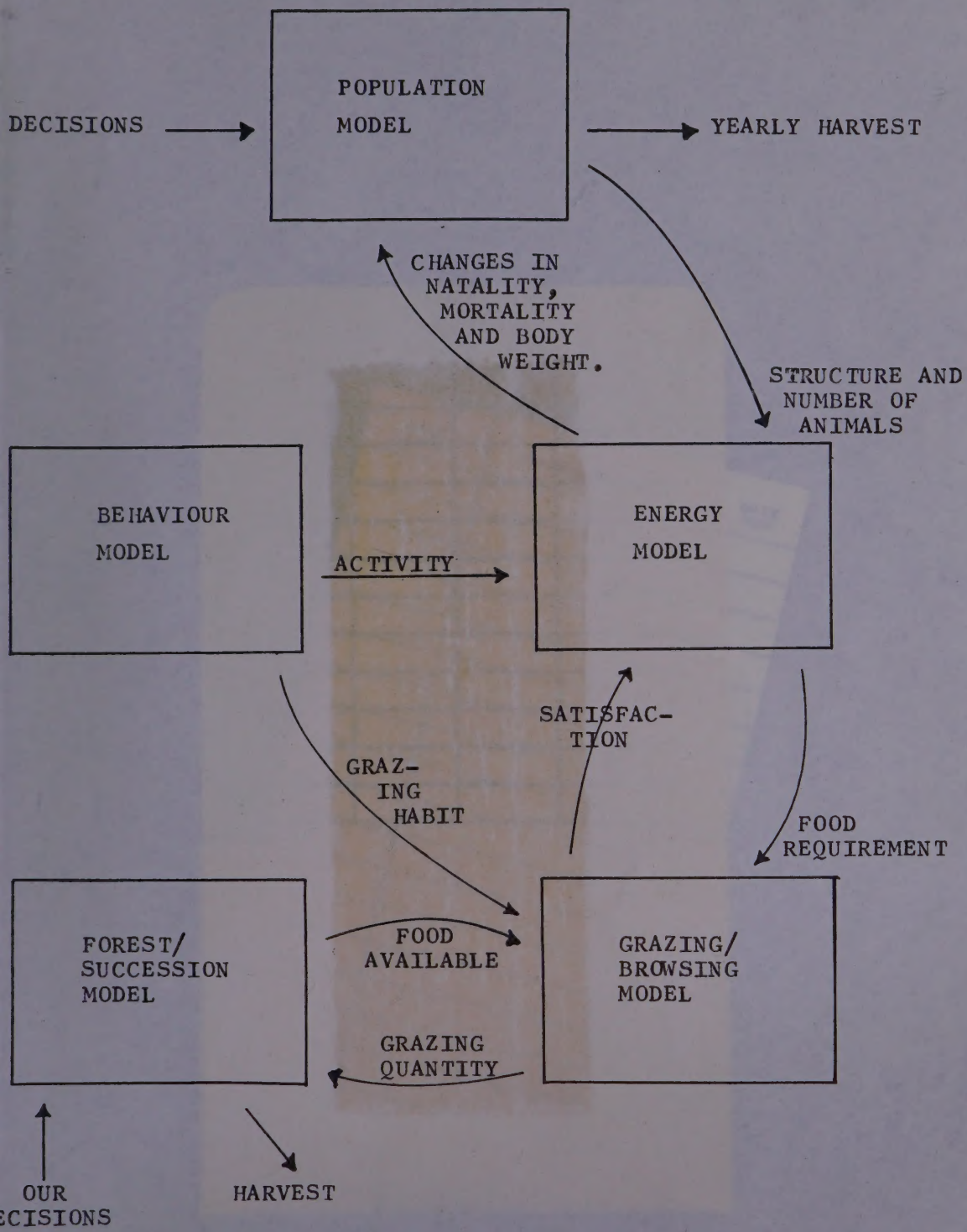

Fig 1. A rough illustration of the sub-models and the relations between those which may compose the first step in a moose - forest model.

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